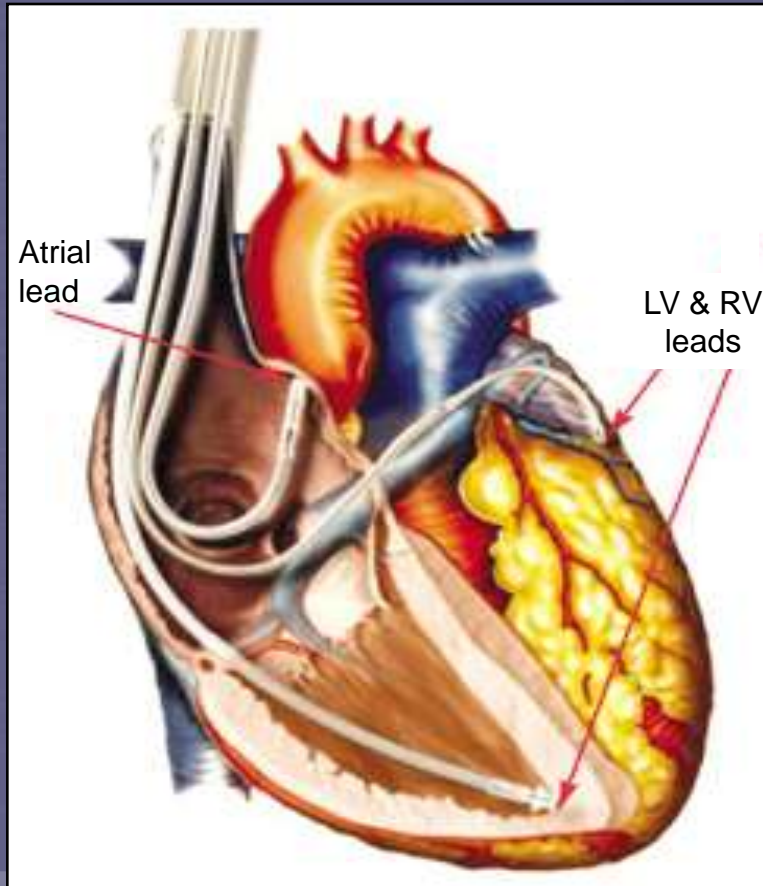


The subcutaneous ICD

How and when to implant

|Current ICD technology



Requires leads/electrodes to be placed “in or on” the heart

-Transvenous

-Epicardial

Morbidity of ICDs in children largely relate to problems with

- Internal leads

- Inappropriate shocks

The S-ICD System...



Totally subcutaneous system does not require electrodes “in or on” the heart

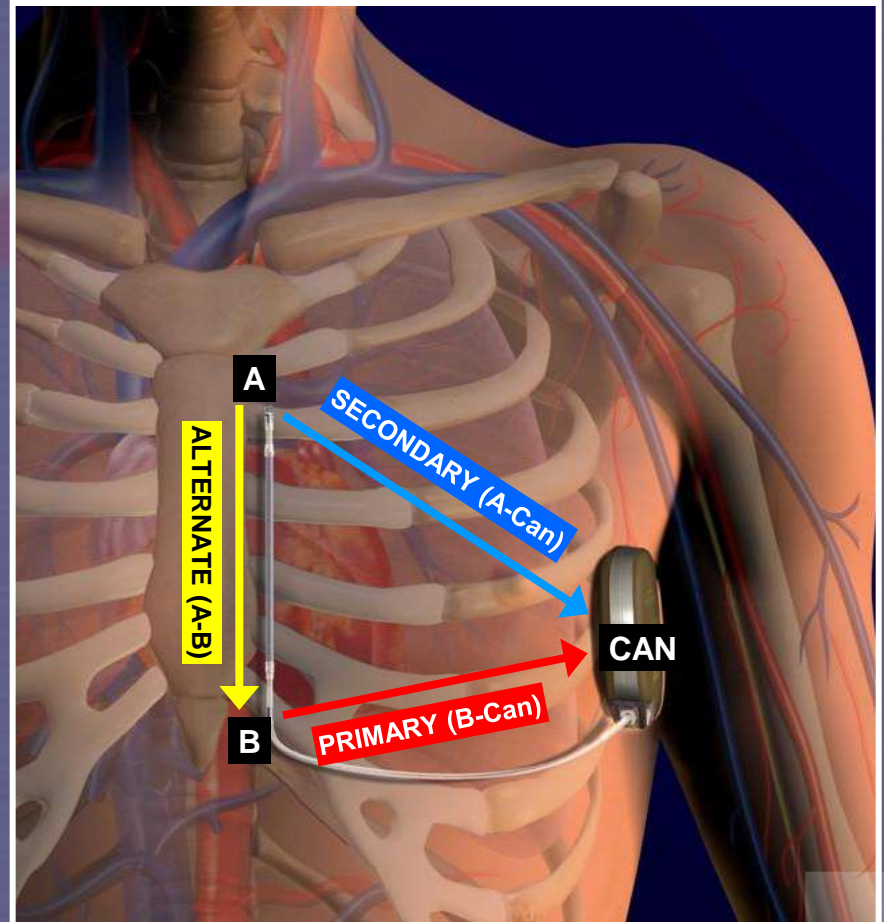
Consists of a generator and a subcutaneous ‘lead’ with two ring electrodes at either side of the coil.

System is placed strictly by anatomical landmarks without a need for fluoroscopy

The S-ICD System

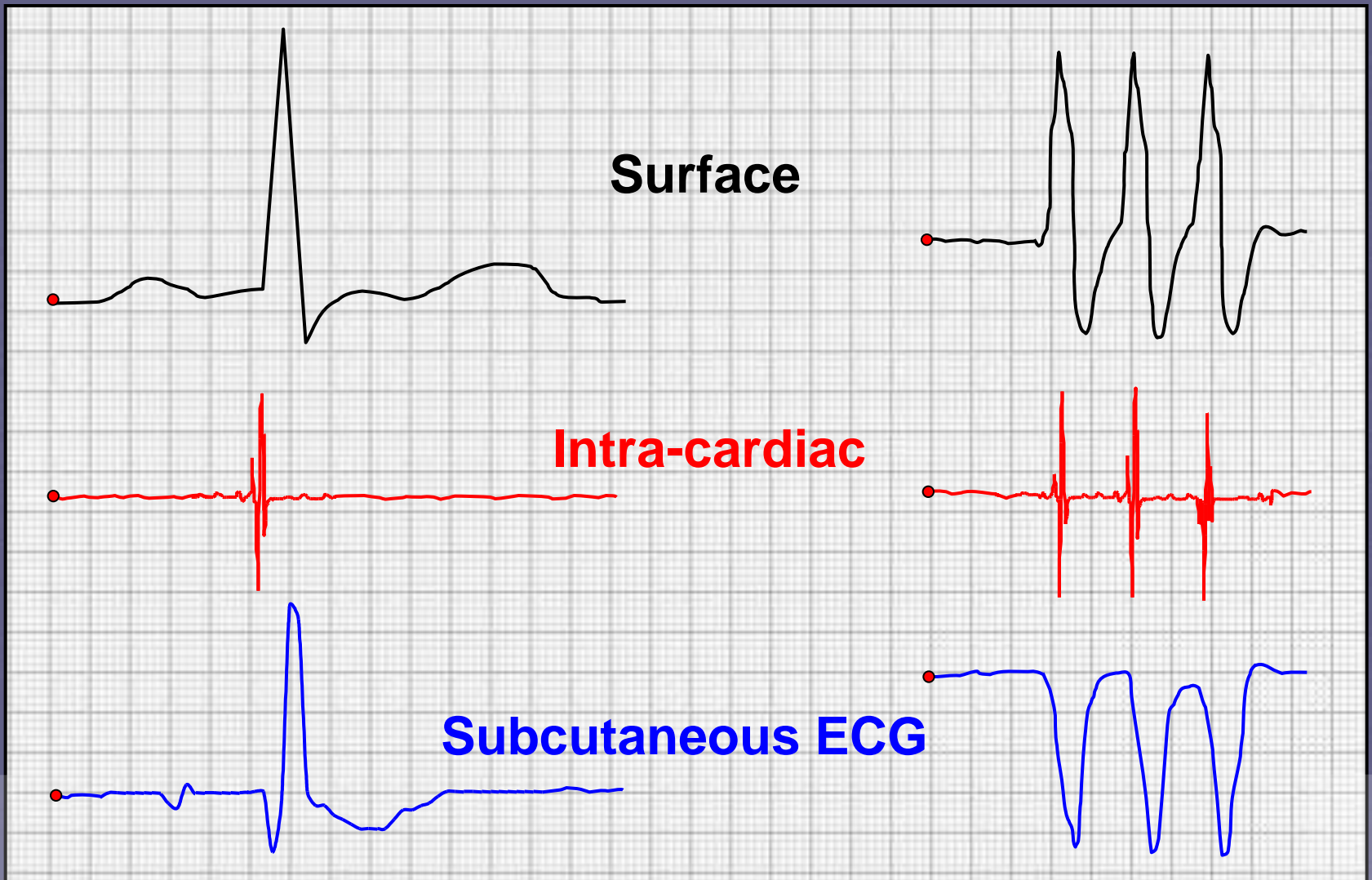
Sensing the subcutaneous signal...

- The S-ICD uses the subcutaneous ECG to monitor heart rhythm and detect ventricular arrhythmias.
- The device chooses the best of three possible ECG vectors obtained using the 2 lead electrodes and the generator.



The S-ICD System

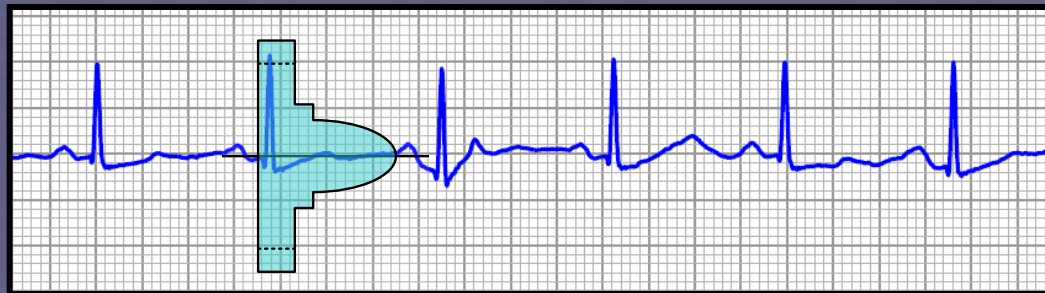
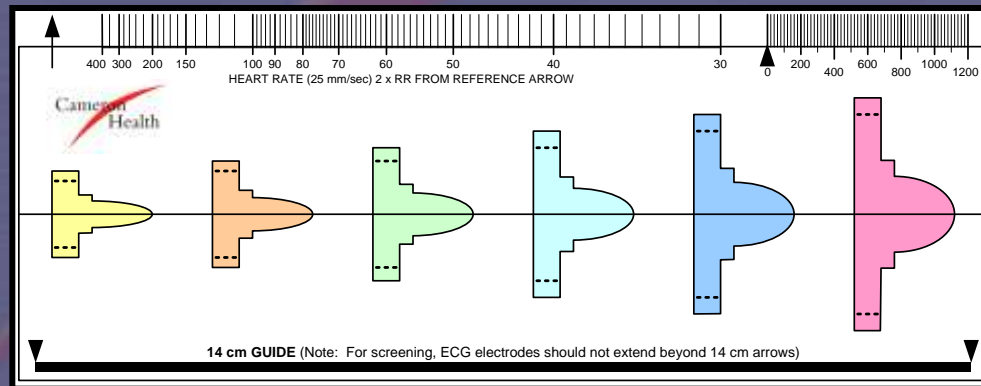
Sensing the subcutaneous signal...



The S-ICD System

Pre-procedural ECG

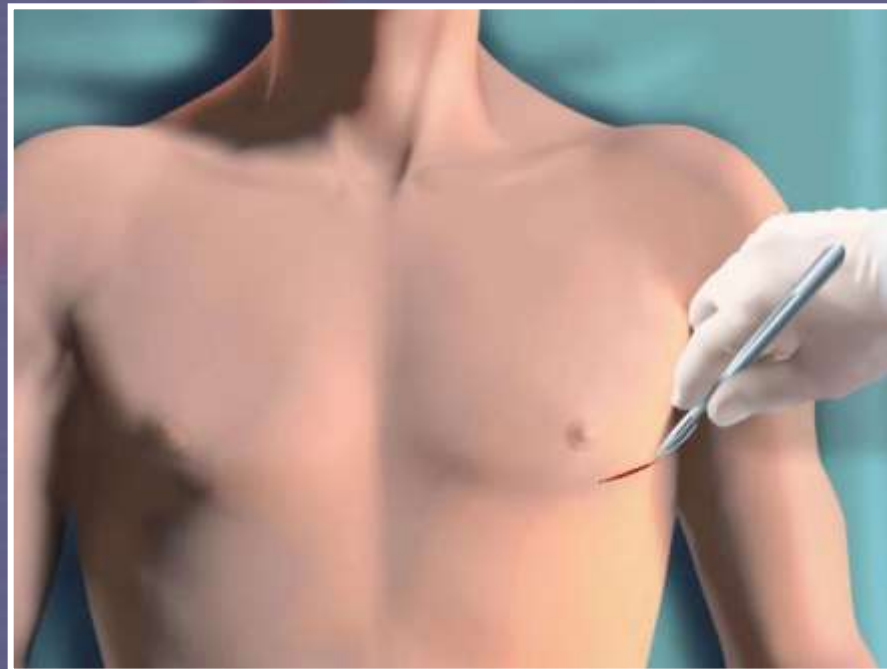
- Pre-operative screening tool
 - Maximizes sensitivity and specificity by providing a pre-operative method to identify patients that have suitable subcutaneous sensing signals.



Implant Method

1. *Creating the device pocket...*

- Device should be placed in the vicinity of the left 5th and 6th intercostal spaces and near the mid-axillary line. The subcutaneous pocket should be big enough to accommodate the generator



Implant Method

2. *Lead placement...*

- Make a horizontal incision beginning 1 cm left lateral of the xiphoid midline
 - Incision needs to be large enough to accommodate the suture sleeve to hold the lead secure



Implant Method

2. *Lead placement...*

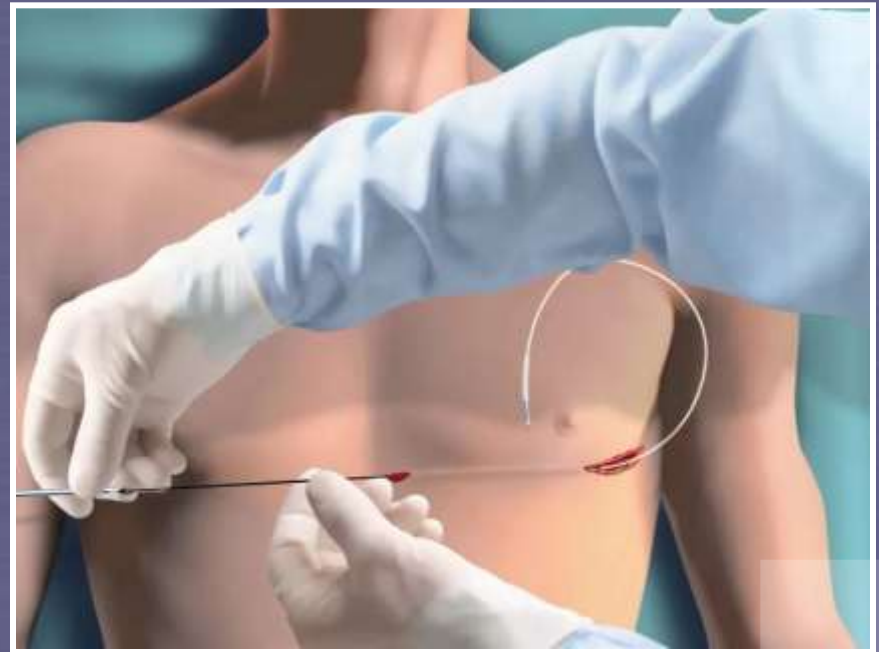
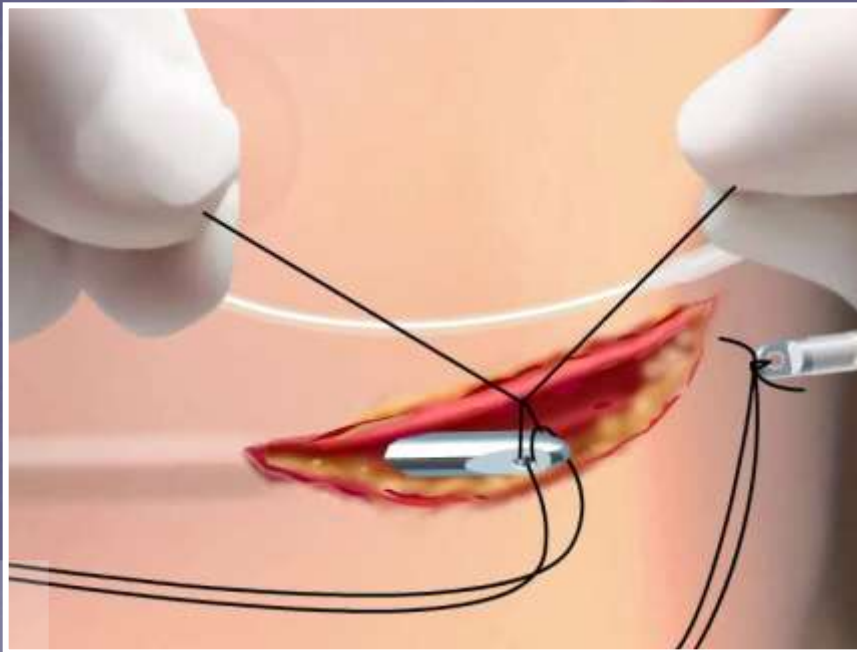
- Tunnel from the xiphoid incision to the pocket using the tunnelling device (Q-TRAK)



Implant Method

2. *Lead placement...*

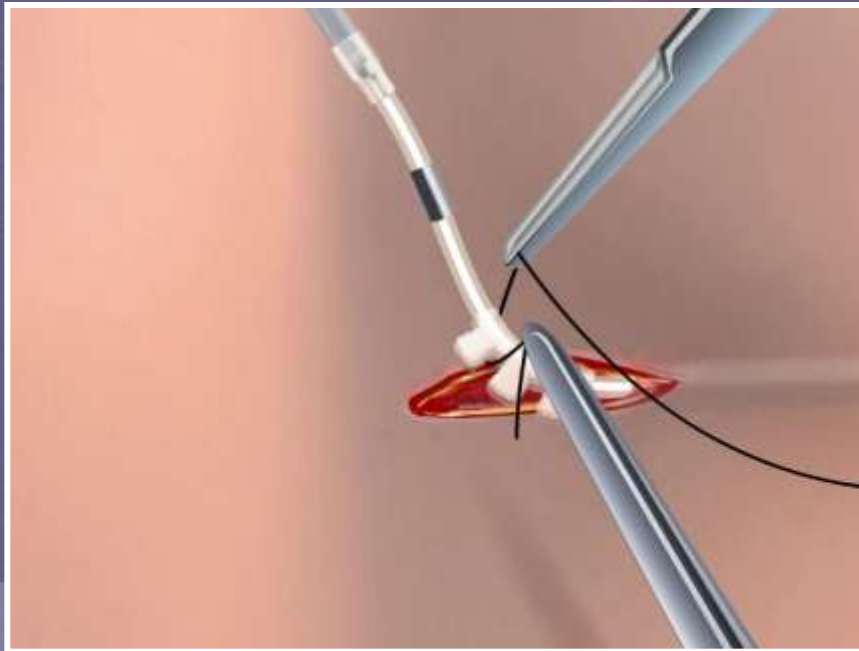
- Tie the distal tip of the electrode to the tunnelling device with a long suture loop (about 20cm loop of silk) and pull lead until proximal electrode lies just outside xiphoid incision



Implant Method

2. *Lead placement...*

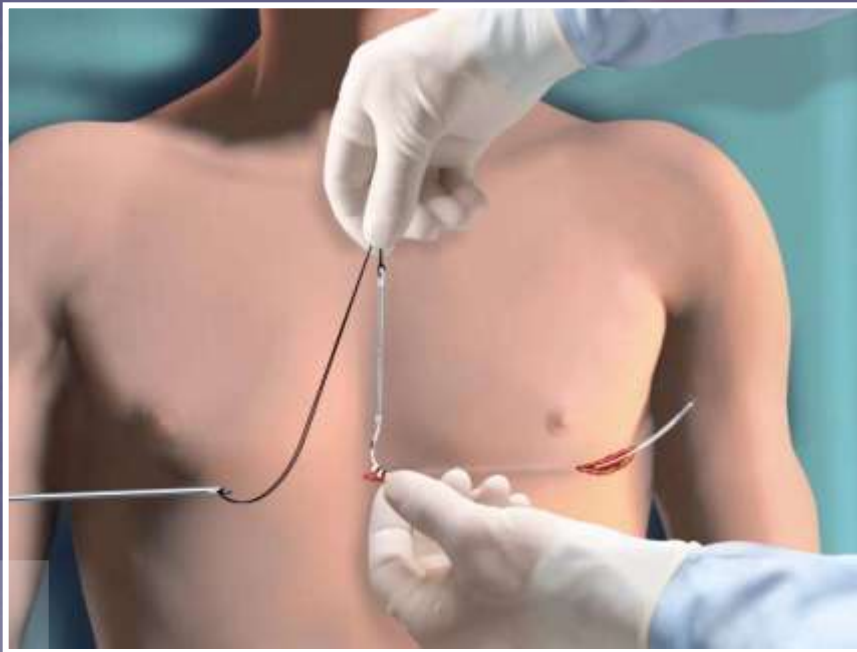
- Attach the suture sleeve to the lead, about 1 cm from the proximal electrode



Implant Method

2. *Lead placement...*

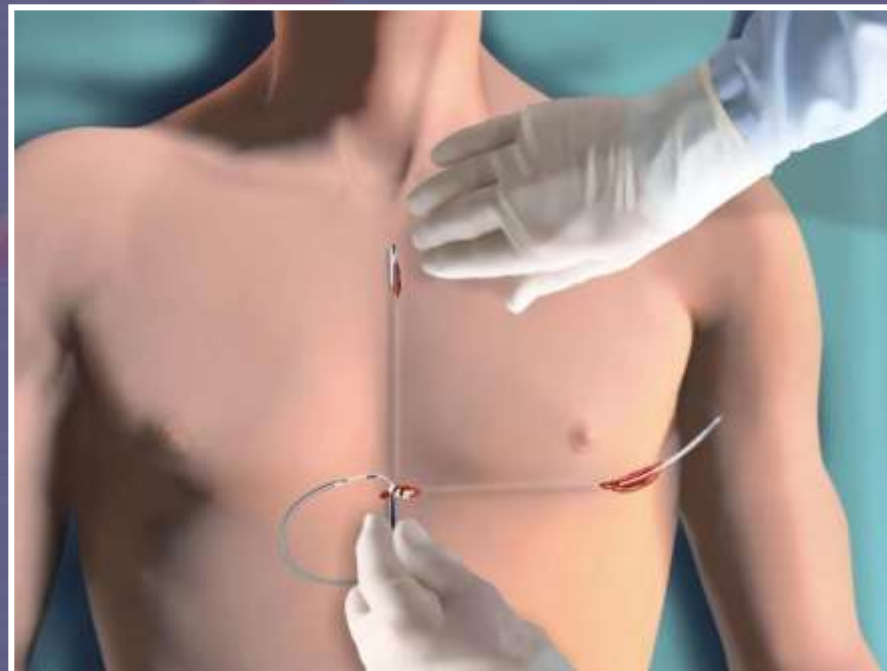
Lay the remainder of the lead on the surface of the chest approximately 1cm to the left of the sternum. Make a vertical incision where the tip of the lead lies.



Implant Method

2. *Lead placement...*

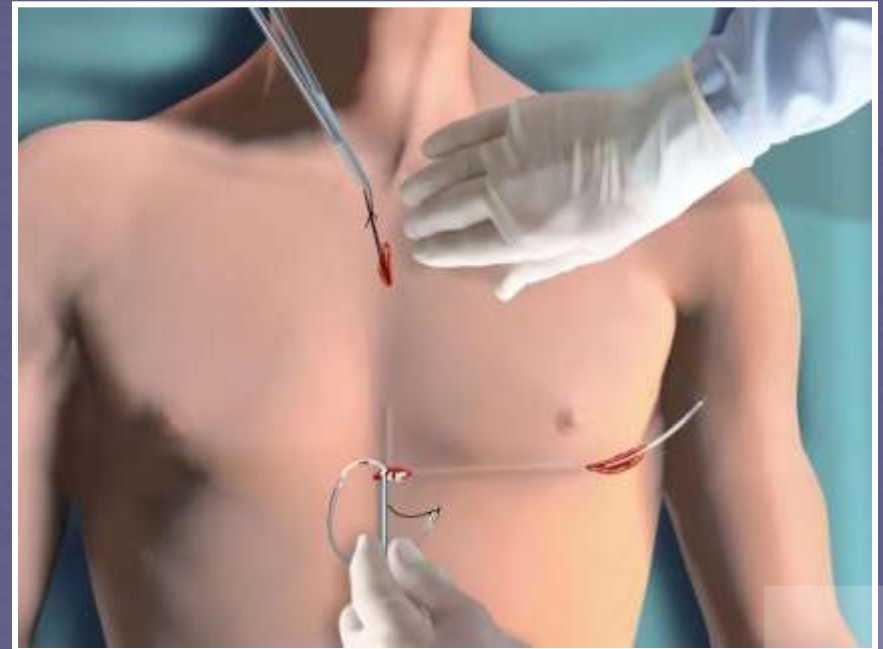
- Tunnel the lead from the xiphoid to the superior incision (tunnel parallel to the sternum)



Implant Method

2. *Lead placement...*

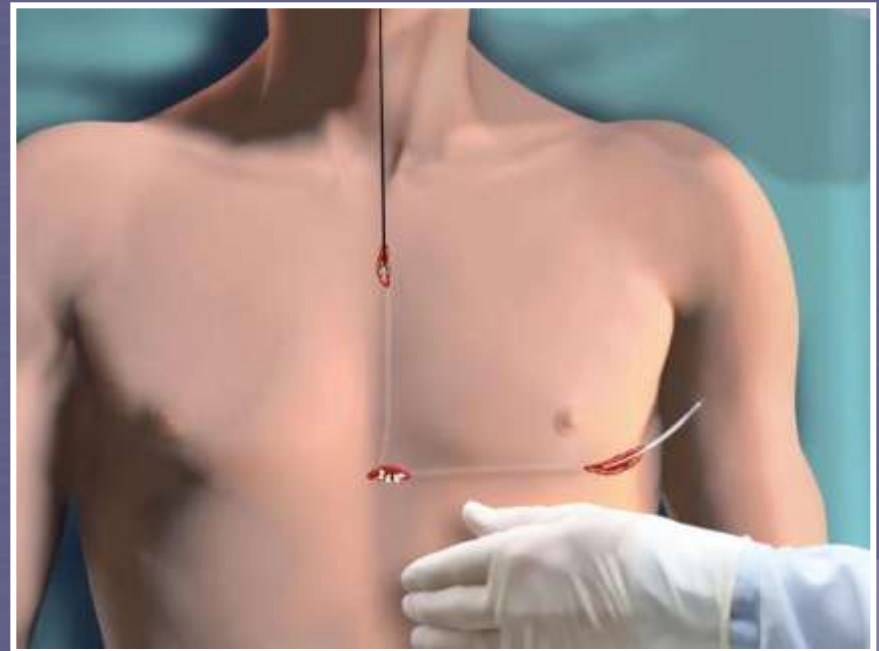
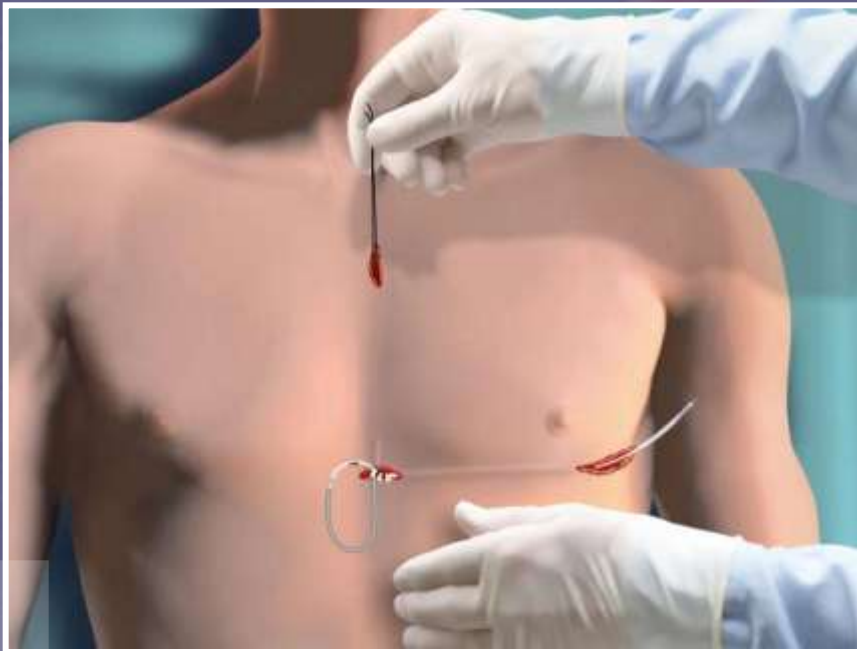
- Cut the suture free from the tunnelling device but keep it attached to tip of the lead.



Implant Method

2. *Lead placement...*

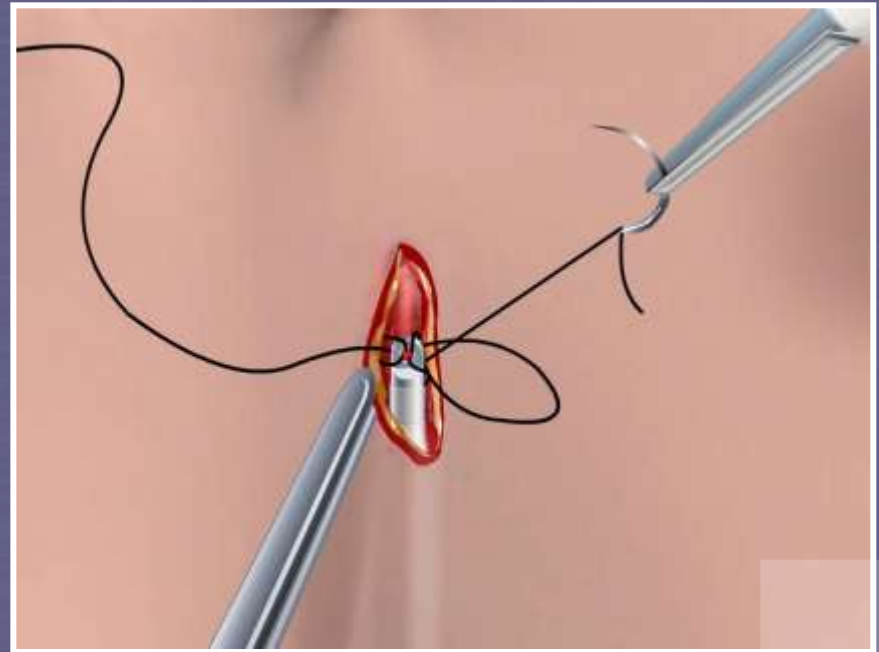
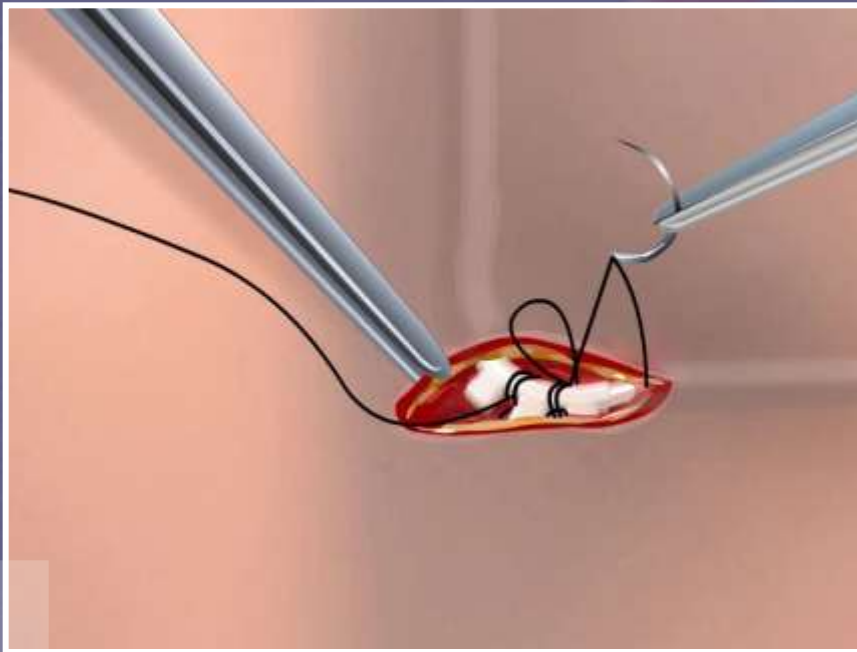
- Using the silk suture, pull the lead tip into the upper sternal wound



Implant Method

3. *Secure lead...*

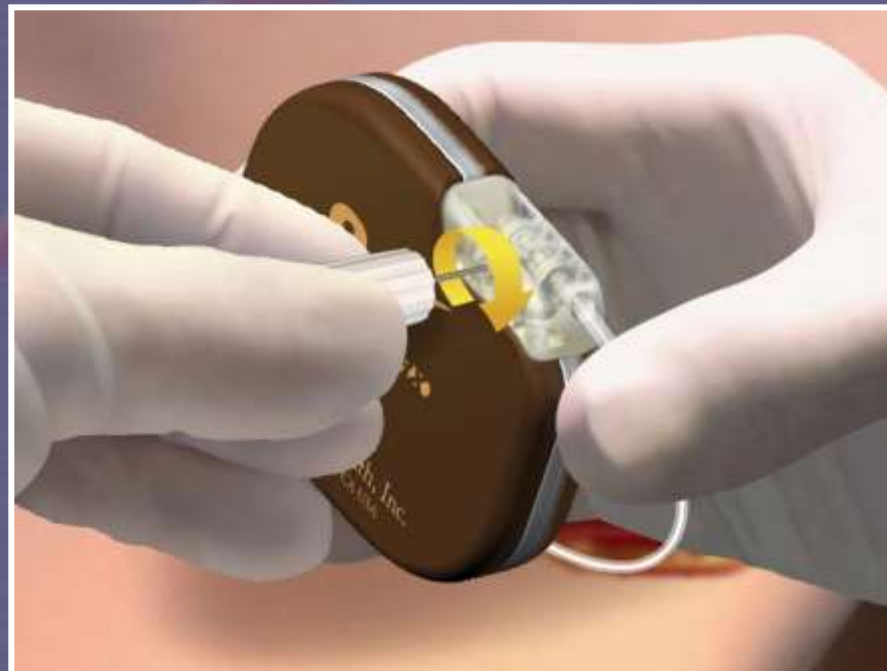
- Suture lead in place at the xiphoid and distal tip using two fascia sutures at each location
 - Perform “tug test” to ensure adequate tissue fixation



Implant Method

4. *Connect lead and insert device...*

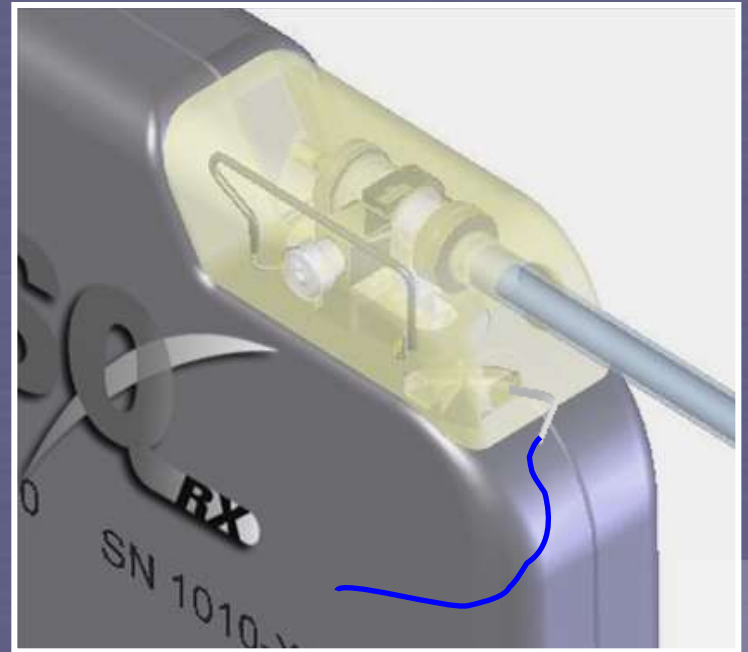
- Use the torque wrench to secure the lead
 - Clicking will be heard when secure



Implant Method

4. *Connect lead and insert device...*

- Insert the generator into the device pocket
- Suture the device in place



S-ICD System

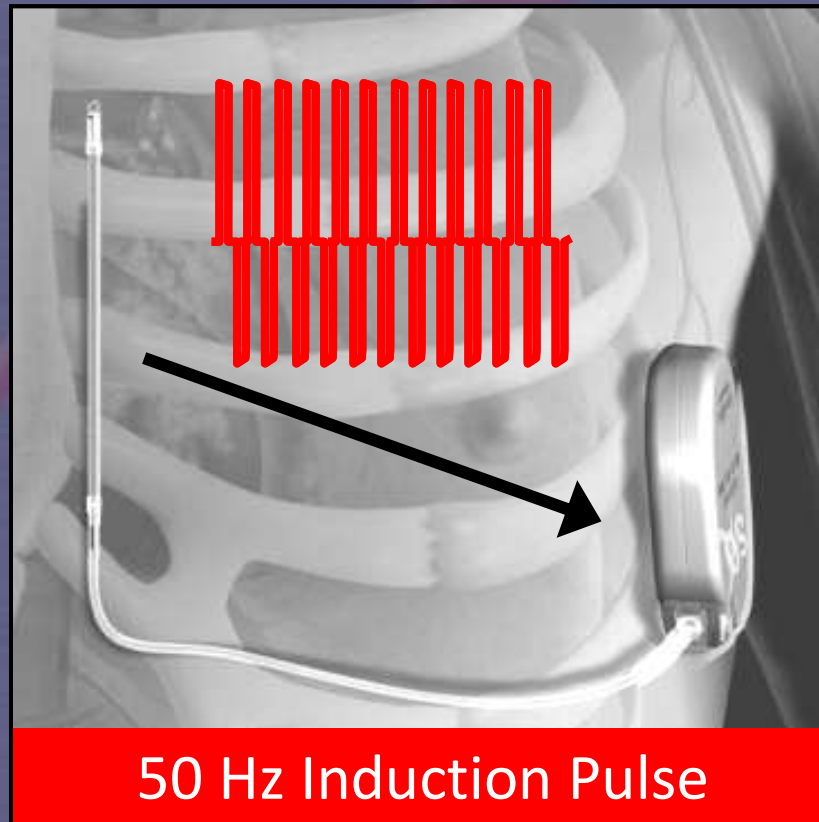
Q-TECH Programmer...



- Battery operated
- Wanded RF telemetry
- Wireless printing

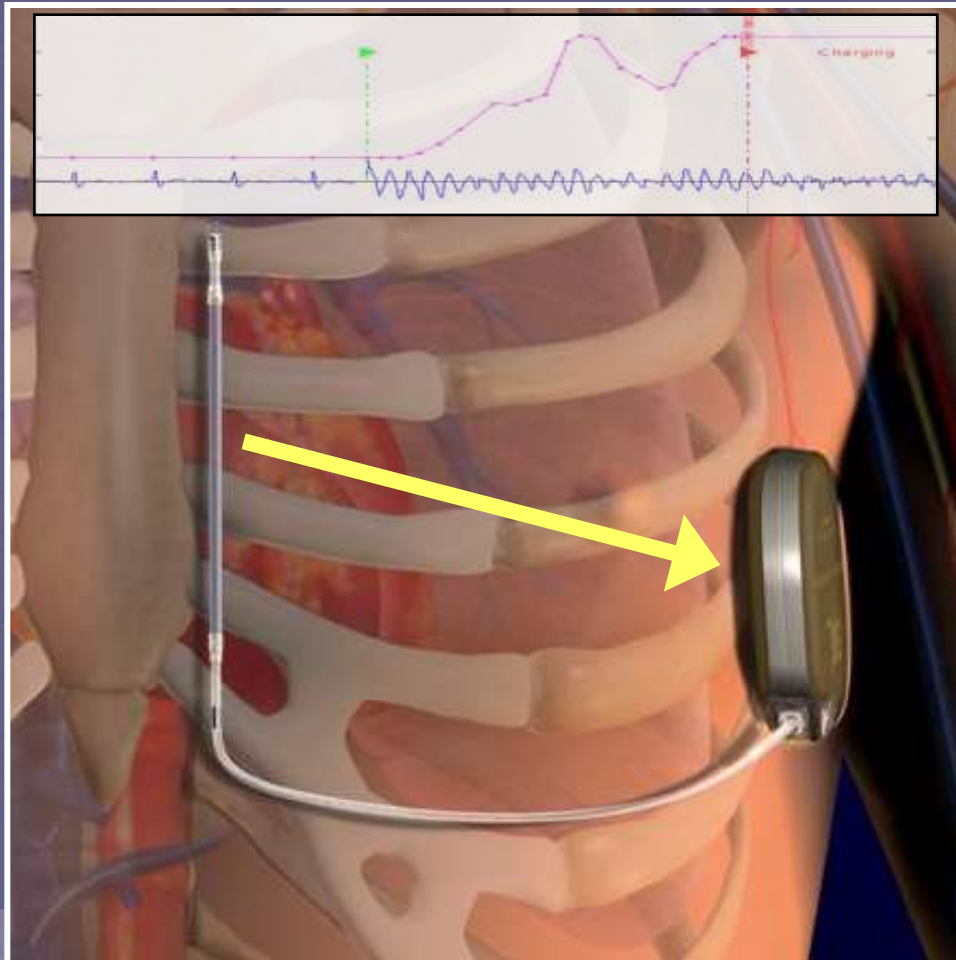
Inducing VF

- Device based induction (200 mA) with programmable first shock energy



The S-ICD System

testing the system at implant



60J shock delivered at time of testing (80J delivered for therapeutic shock)

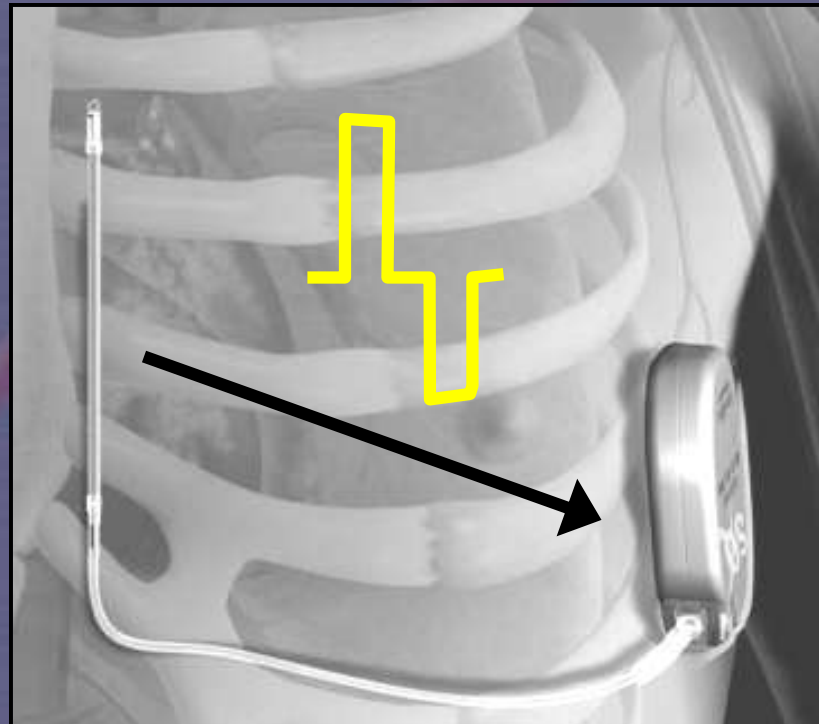
Biphasic shock

Charge time is approximately 9 seconds to maximum output

S-ICD System

post shock pacing

- Post-Shock pacing available for up to 30 seconds
- Demand based pacing @ 50 ppm using 200 mA



Standard Polarity Pace

ICD leads...

TRANSVENOUS

- Exposed to >30 million cardiac contractions/yr
- Requires durability and flexibility

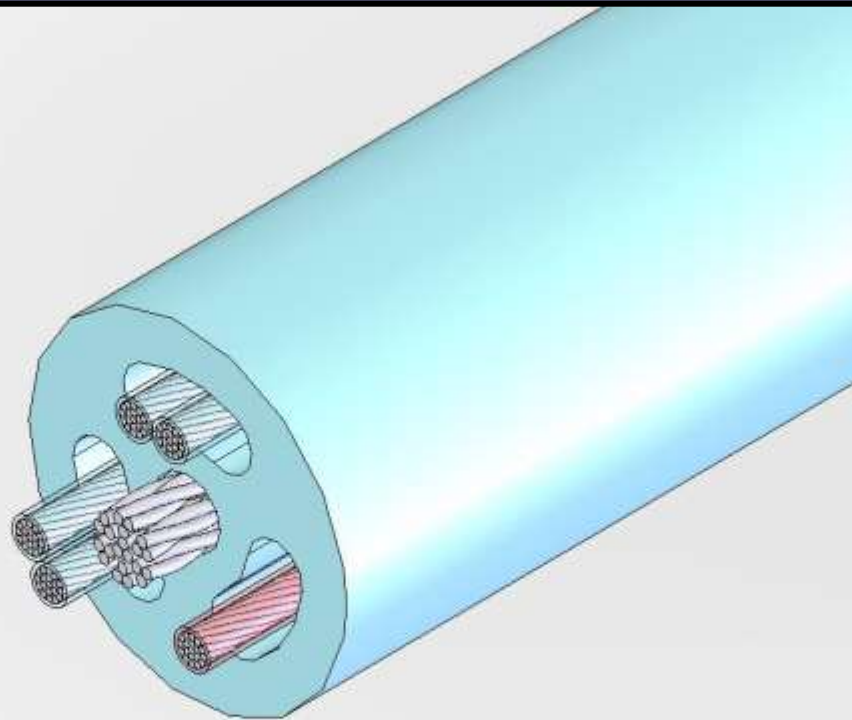
SUBCUTANEOUS

- Exposed to low stress and motion
- Designed to be stronger and less prone to failure

S-ICD System Components

Q-TRAK™ lead

Cable core design



Superior axial strength

When should you implant a SC-ICD?

- When patients fulfil the criteria for ICD implantation but do not require chronic pacing.

Glasgow experience of S-ICD in children

- 5 patients < age 18 years
 - * HCM, boy, age 10
 - *LQTS – mutation on HERG, boy age 12
 - CPVT, mutation on RyR2, girl age 14
 - *Unexplained VF arrest, boys, age 15 and 17(*First presentation with cardiac arrest)

Weight at time of implant 32- 103Kg

Glasgow experience of S-ICD in children

- All children had excellent pre-procedural ECGs that easily fulfilled the criteria for a S-ICD system
- Procedures uncomplicated
- VF induced at first attempt in all
- All successfully cardioverted with 1 x 60J shock from the device
- Boy with LQTS had 3 beats of post shock pacing
- Time from induction of VF to delivered shock 13-18 seconds

Glasgow experience of S-ICD in children

- Follow up range 3-11 months
- Device reprogrammed to a different subcutaneous ECG vector in one patient (103Kg boy) due to muscle activity interpreted as non-sustained VT
- No shock, inappropriate or therapeutic delivered
- All patients well

S-ICD System

SQ-Rx Pulse Generator

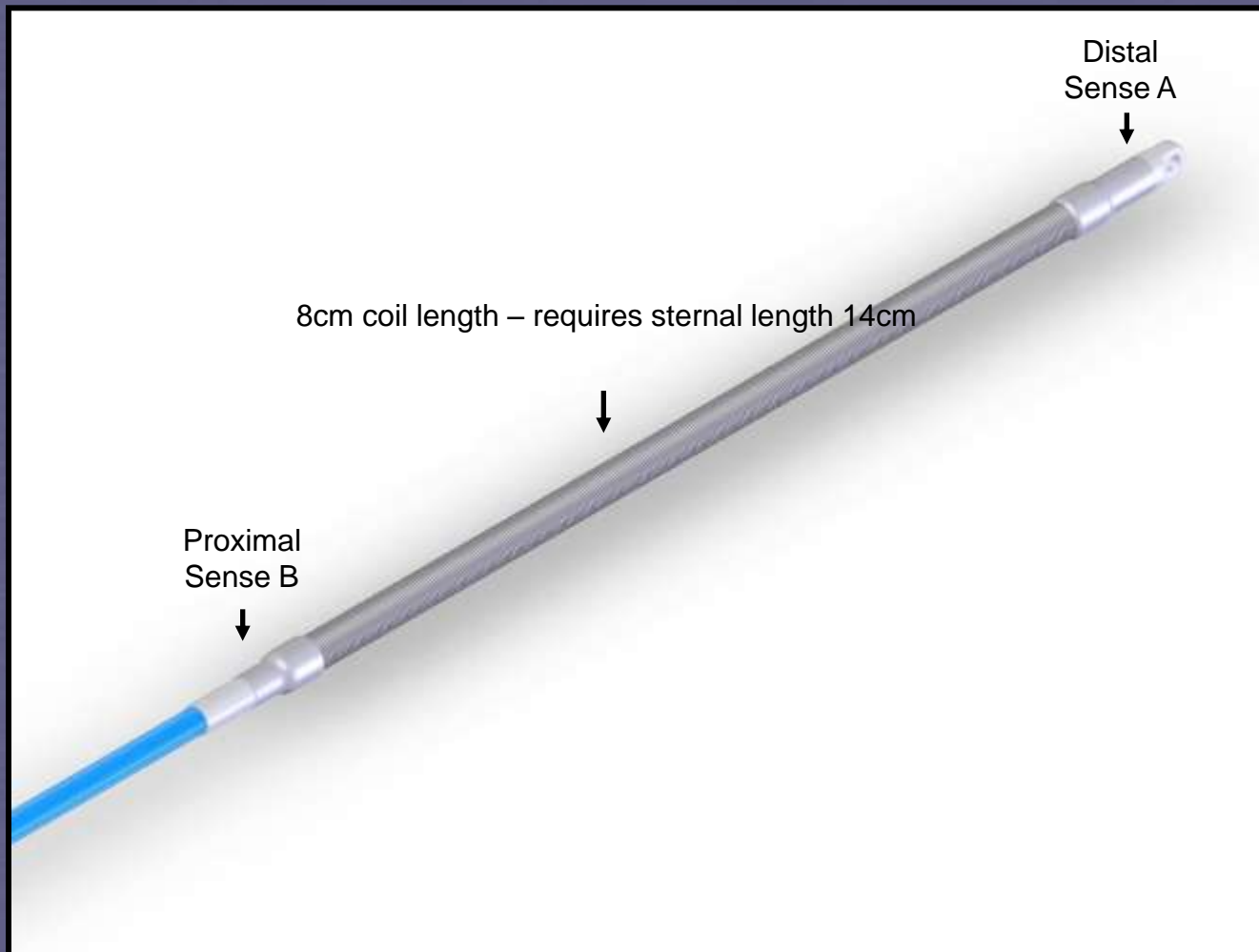


Volume: 69 cc
Weight: 145 grams
Thickness: 15.7 mm
Energy: 80J
Waveform: Biphasic

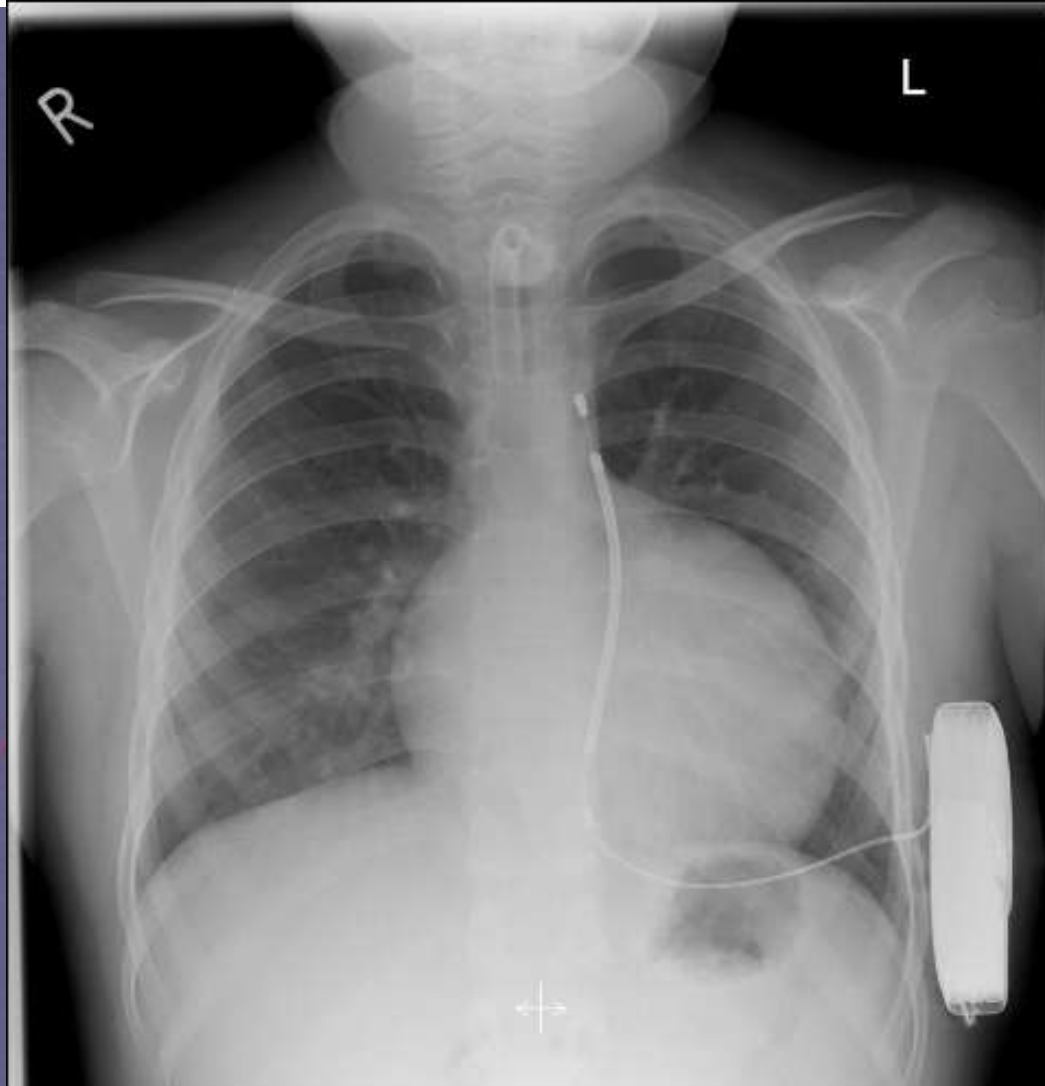
- Volume: 35 cc
- Weight: 70 grams
- Thickness: 9-11mm
- Energy: 32J
- Waveform: Biphasic

S-ICD System lead

Coil length to deliver 80J



HCM, weight 32Kg, age 10 years





**HCM age 10
years, weight
32Kg.**



Truly Paediatric S-ICD possible.....

- S-ICD designed for no upper weight limit – delivers subcutaneous shock of 80J
- Children < 30Kg should defibrillate with subcutaneous shock of <30J (size of current transvenous ICD)
- Smaller shock would allow shorter coil
- Should be able to develop truly paediatric S-ICD suitable for children <30Kg
- Prediction: The ICD of choice for patients who require an ICD who do not require chronic pacing